Agile Support Project — Global Hawk Program

Rapid Supply, Responsive Logistics Support for Next-Generation UAVs

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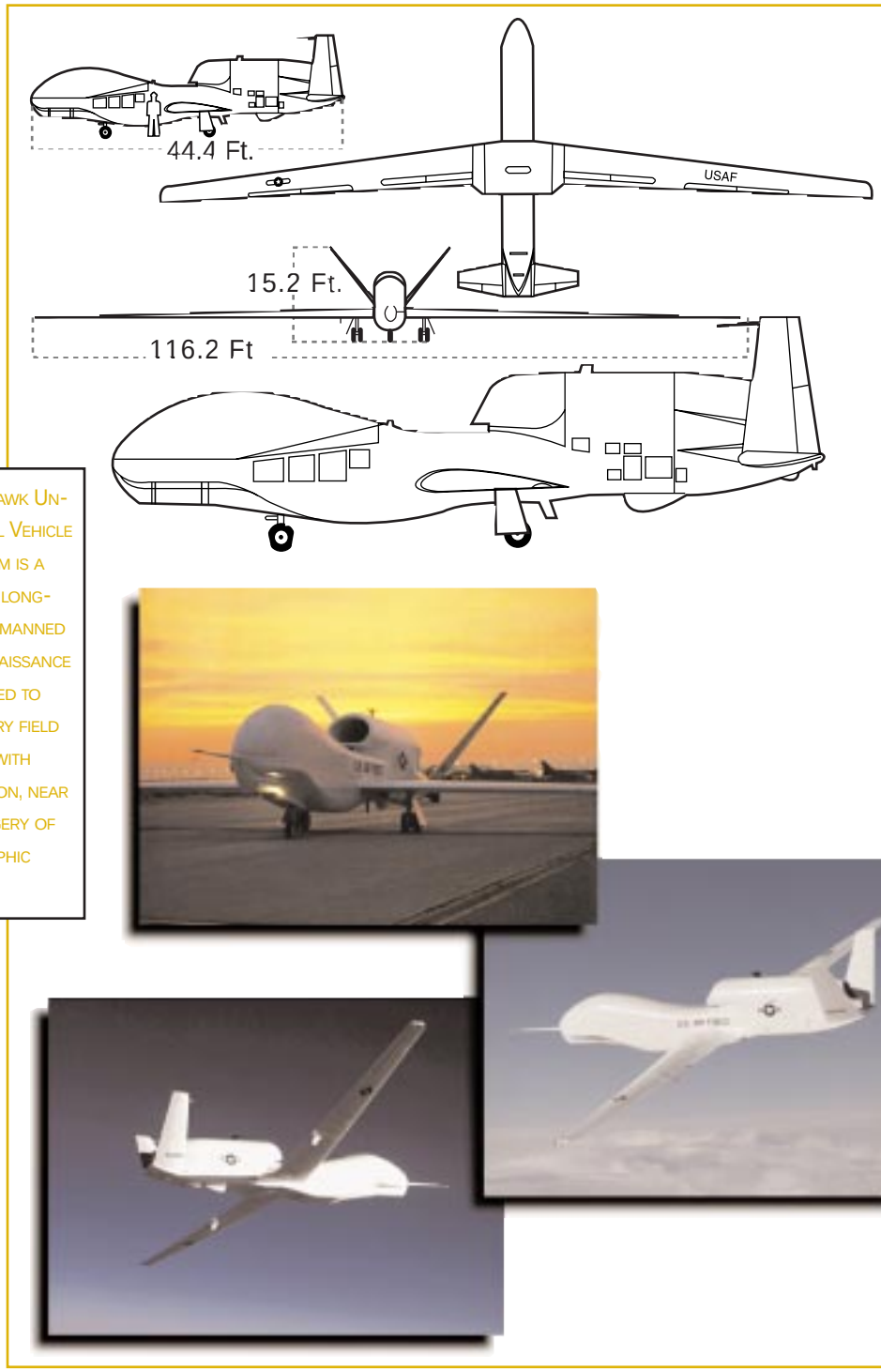
The Global Hawk Unmanned Aerial Vehicle (UAV) program is a high-altitude, long-endurance unmanned aerial reconnaissance system designed to provide military field commanders with high-resolution, near real-time imagery of large geographic areas. Designated as an Advanced Concept Technology Demonstration (ACTD) program, Global Hawk is funded by the Defense Airborne Reconnaissance Office (DARO) and managed by the Defense Advanced Research Projects Agency (DARPA).

The 14,000-nautical-mile range and 42-hour endurance of the air vehicle, combined with satellite and line-of-site communication links to the ground segment, will permit worldwide operation of the system. High-resolution sensors, which can look through adverse weather day or night from an altitude of 65,000 feet, will conduct surveillance over an area the size of Illinois in just 24 hours..

THE GLOBAL HAWK UNMANNED AERIAL VEHICLE (UAV) PROGRAM IS A HIGH-ALTITUDE, LONG-ENDURANCE UNMANNED AERIAL RECONNAISSANCE SYSTEM DESIGNED TO PROVIDE MILITARY FIELD COMMANDERS WITH HIGH-RESOLUTION, NEAR REAL-TIME IMAGERY OF LARGE GEOGRAPHIC AREAS.

Affordable Logistics Support

ACTD programs such as Global Hawk typically include the delivery of a limited quantity of prototype units for eval-



Klement is an Engineering Director at GDE Systems in San Diego, Calif. Currently she is managing a new technology program in support of the latest reconnaissance plane (Global Hawk). She is the author of five technical papers on the applications of logistics technology and has produced six films on this subject. She holds a bachelor's and master's in Physics as well as a master's in Engineering Management.

Photos/Images courtesy Teledyne Ryan Aeronautical

uation and potential operational use. One problem this poses is the difficulty of providing affordable logistics support for the user when there is little economy of scale, and of meeting readiness and sustainability when a part fails and a spare is not immediately available.

Due to the lack of a formal logistics support system consisting of trained maintenance specialists, technical manuals, and a large inventory of spare parts, the user must rely on the contractor for supplementary troubleshooting assistance and for rapid resupply of spares.

Agile support concepts offer a solution to this problem by demonstrating innovative ways to provide affordable logistics support to an ACTD program. These include the development of a real-time maintenance network, rapid resupply of key suppliers using commercial business techniques and strategic business relationships, and reduced inventories of spare parts.

The application of Agile support concepts to the Global Hawk program results in a $22-million decrease to the overall life-cycle cost of the program, while contributing to a 20-percent increase in operational availability.

Agile Support Program in Brief

The Agile Support Integrated Product Team (IPT) led by GDE Systems, consists of team members from Teledyne Ryan, Raytheon Systems Company, L-3 Comm, and TASC. Together, our team is developing an 18-month, two-part Agile Support program consisting of a simulation and analysis effort and a demonstration effort. During the simulation and analysis phase, we will investigate and assess supportability enhancing techniques. Our investigation and assessment will then be followed by the demonstration phase, where we will demonstrate Agile technologies to improve the supportability of the Global Hawk system.

Our program is being conducted concurrently with Phase II of the Global Hawk Design program. Developed by our IPT, the implementation plan provides a limited inventory of spares to augment the current inventory early in the flight test program. This leaves in place a cooperative business organization with a secure telecommunications network that provides connectivity between Teledyne Ryan, the flight test site at Edwards AFB, and major suppliers for rapid resolution of support problems (Figure 1).

Elements of Agility

The Agile support program consists of the following key elements:

- A telemaintenance system that has been put in place to link up the operational and flight test bases with the Teledyne Ryan Action Center and its key suppliers.
- An automated fault diagnostics capability used for troubleshooting, consisting of expert systems and integrated database and digital images of the problem areas.
- Supplier strategic partnering consisting of electronic web-based procurement of spares and supplier agreements for rapid spares delivery.

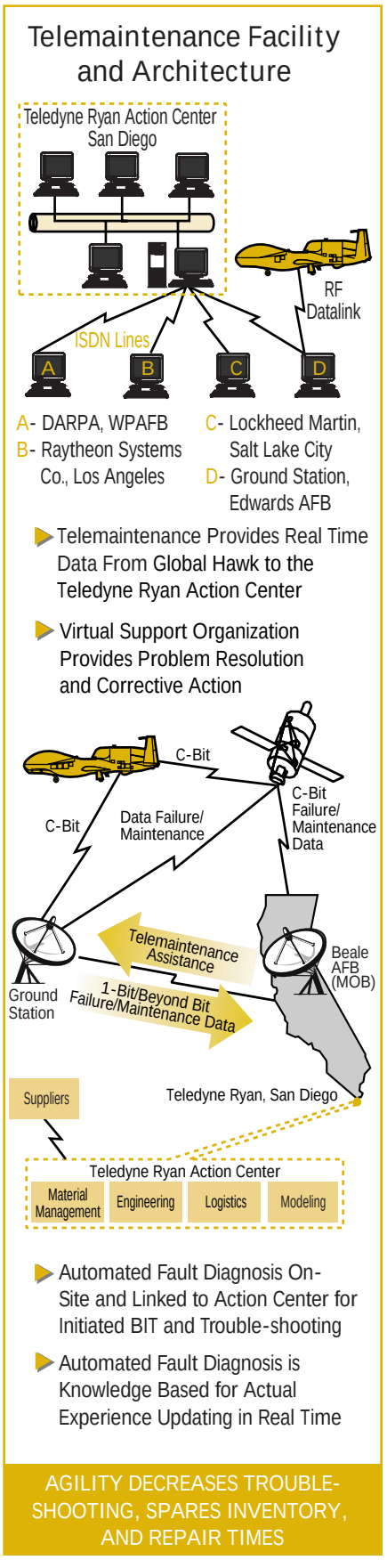
Our team evaluates all of these elements for cost and mission availability benefits using our discrete event simulation model customized for Global Hawk and the government-provided Cost Analysis Strategy Assessment (CASA) Life Cycle Cost Model.

Telemaintenance

Under telemaintenance, we have established an Action Center at Teledyne Ryan Aeronautical (TRA) that uses data results from the automated fault diagnostics process, assessment tools to provide logistics and operations options and strategies, and experts to initiate and coordinate solutions to complex maintenance and logistics problems.

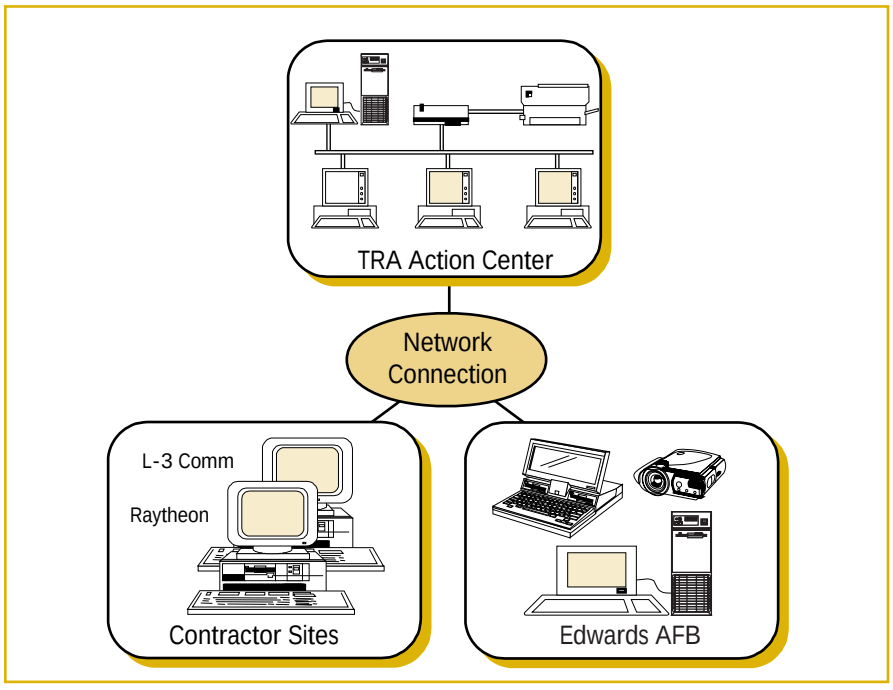
To expedite the solutions to hardware and software maintenance problems, we have installed a communications network that connects the TRA Action Center, the maintenance repair site, and product experts not located at TRA. To further enhance the process, we use a digital camera at the flight test site to transmit real-time images to clarify or

FIGURE 1. Agile Support to the Global Hawk Program



AGILITY DECREASES TROUBLE-SHOOTING, SPARES INVENTORY, AND REPAIR TIMES

FIGURE 2. Agile Logistics Hardware and Network Configuration



amplify a specific condition. Figure 2 shows the Agile Logistics hardware and network configuration.

Automated Fault Diagnostics Capability

The Agile program uses the results of the failure modes and effects analysis previously conducted on selected air vehicle systems (and the associated functional block diagrams, failure, test and monitor logic generated on the Global Hawk program) to create an integrated database. An Automated Fault Diagnostics (AFD) process is developed that takes the established logic and uses failure and status indicators (i.e., Symptoms List) for input to perform fault isolation and detection.

The results (i.e., failure causes) are then put before the experts (technical support) for validation. This forms the basis for an evolving AFD expert system hosted on a PC that organizes symptoms, failures, and test and repair procedures in a logical structure.

Now that Global Hawk flight-testing has commenced, the air vehicle fault log data are being downloaded from the Vehicle Test Controller (VTC) after every flight. For diagnostic capability, a fault log is read from the UAV after it is on the ground through a portable maintenance computer with a 1553 bus connection. This log is then downloaded through the server at Edwards to the Action Center at Teledyne Ryan where automated diagnostic software, expert systems, and fault recording determine what is wrong and how to fix it.

Relevant maintenance instructions are accessed remotely while a spare is requested electronically. This allows the UAV to transmit failure data and symptoms in real time and update the Action Center electronically. As the UAV transitions to production, these data could be used to provide designers with a baseline for design changes or to begin the design at a future date after the ACTD program has stopped and the UAV technology has been proven.

Supplier Strategic Partnering

Global Hawk is demonstrating Spares-On-Demand by procuring Line Replacement Units (LRU)/subsystems critical to the success of the flight test program using virtual organization business arrangements, rapid response provisioning, and strategic partnering. LRUs/subsystems/piece parts are selected for procurement from the list of candidate flight and mission-critical parts. Basic Ordering Agreements (BOA) are made with suppliers of the selected repair parts defining cost, lead time, and supplier support relationships that will enable rapid response to requisitions for the repair parts. The suppliers are connected to the telemaintenance network to form a virtual business organization that can react rapidly to procurement decisions.

With the BOAs in place, a Procurement Action Review (PAR) is conducted with DARPA and a decision made to initiate procurement of the selected repair parts. When the procured parts are delivered, the costs and delivery lead times of the Agile procurement effort are compared with a standard procurement process to determine the relative benefits of each. In order to implement spares-on-demand, we incorporated the following Agile techniques:

- Strategic Partnering
- Multi-tier Purchasing Agreements
- Vendor Certifications
- Delivery to Point of Use
- Vendor Base Consolidations
- Networked Information Systems and Resource Planning
- Rapid Supply Chain Contracting
- Electronic Data Interchanges

These techniques form the basis for a rapid resupply network of spares, which enhances the overall readiness of the Global Hawk system while reducing the logistics support costs. A brief description of each follows:

Strategic Partnering

The suppliers chosen for the Global Hawk Program were, in many instances, unaware of Agile support techniques to improve procurement and contracting lead times. As a result of investigating ways to increase efficiencies and develop more interest in electronic ordering via the Internet, suppliers to TRA have positioned themselves as strategic partners for future TRA projects. Raytheon Systems Company and L-3 have adopted Agile support techniques to provide

spares and repairs on a more timely basis. Several representative examples of these Agile support techniques from our vendors are worthy of mention.

L-3 Communications. To expedite spares orders, L-3 has implemented electronic ordering, multi-tier purchasing agreements to reduce cost and schedules, strategic partnering, vendor certifications to eliminate process times, and direct deliveries of repaired LRUs to Edwards AFB.

Raytheon Systems Company
By using the agility method of stocking critical parts, Raytheon has placed four of the Integrated Sensor Suite (ISS) Synthetic Aperture Radar (SAR) transmitter parts at their vendor's facility to expedite transmitter repair. This method of procurement will reduce cost and shorten repair lead time.

The delivery lead-time of a spare transmitter to Raytheon from their vendor is approximately 24 weeks. The longest lead time associated with the four critical parts is 20 weeks. This reduces the lead-time by four weeks. The cost savings by using this method is approximately $30,000, the difference between buying and stocking a spare transmitter or buying and stocking the four critical parts. The 12 weeks needed to build the traveling wave tube (TWT) at the supplier's facility in Los Angeles will also be reduced to 10 weeks by expediting the procurement process.

Mercury Computer Systems Inc., and the Mercury Processor Card
Mercury Computer Systems Inc., has offered an Air Spare Maintenance Agreement that commits to an overnight delivery of a spare Mercury Processor Card to any repair site within the continental United States.

From an Agile support techniques standpoint, Mercury will have a spare card available on their shelf for immediate shipment when required. This negates the need to purchase spare Mercury Processor Cards and substantially reduces support costs.

Raytheon and the Processor Control Unit Cards
Raytheon has purchased a jumbo repair kit for the Processor Control Unit Cards. This kit will be used to repair both units, which are part of the receiver/exciter in the Integrated Sensor Suite Synthetic Aperture Radar. This provides a substantial cost savings over purchasing each unit as a spare. By having this kit on hand at the vendor facility, the repair turnaround time will be reduced to one week.

Multi-Tier Purchasing Agreements

To ensure that repairs will be processed on an Agile basis, TRA will have Raytheon store, manage, and control all Raytheon-supplied Agile spares. This function also includes the management of repairs directly with their vendors. To accomplish this, Raytheon will contract directly with Mercury Computer Systems Inc., for the repair of the processor cards and their transmitter vendor for transmitter repairs.

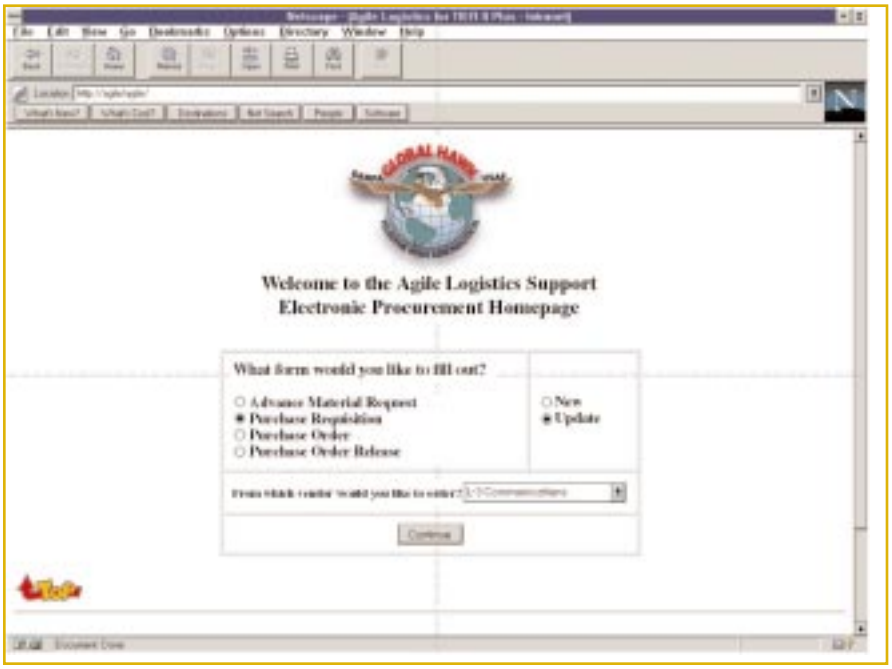
These multi-tier repair arrangements will eliminate many hours of paperwork processing by the contracting departments for each required repair. During the next phase of the Agile Support Project, our team will analyze and verify the time-savings. This method of having a major supplier responsible for the total management of spares distribution, repair, storage, quality assurance, and shipping will demonstrate the Agile support technique of multi-tier purchasing agreements.

Vendor Certifications

As a standard practice, TRA has implemented a Supplier Product Excellence Program (SPEP). This program certifies selected suppliers for quality in manufacturing and administration and for consistent delivery of quality parts and hardware. SPEP suppliers must follow stringent quality guidelines that include on-site surveys, timely deliveries, and implementation of Statistical Process Control (SPC) with adherence to the SPEP guidelines. This has not been easily achieved for most SPEP candidates. To date, 15 suppliers have completed certification.

Unfortunately, none of the 15 suppliers is currently providing Agile spares. However, the Agile support project is constantly monitoring the SPEP program for additional certified suppliers. Once

FIGURE 3. Agile Logistics Support Electronic Procurement Home Page



an Agile supplier is certified, the process for purchasing parts will become extremely abbreviated due to the fact that source and receiving inspections will no longer be required and the supplier will be used more frequently with minimal paperwork.

Delivery to Point of Use

Spares purchased under the Agile contract to support Global Hawk flight testing will be stored at TRA and subsequently shipped directly to Edwards AFB, with the exception of Raytheon spares. These parts will be stocked at Raytheon for accomplishing LRU repairs.

TRA is making every effort to create an Agile environment during the repair process. One very effective method to achieve agility is to have Raytheon dropship repaired parts directly into Edwards AFB in lieu of shipping to TRA. This delivery-to-point-of-use method will save countless transportation and administrative hours.

Vendor Base Consolidations

This Agile support technique would be very effective on contracts that contain hundreds of suppliers. To streamline the acquisition process on a large program, a supplier analysis and assessment would have to be initiated to determine where vendor base consolidation would be practical. On this particular program, spares were purchased to demonstrate agility from seven very specialized suppliers.

Consolidation would have been extremely impractical for a program this small. However, to avoid some of the initial confusion and the issues encountered with changing procurement processes with seven suppliers, consolidation to one supplier would have made the change process less stressful and certainly more agile.

Networked Information Systems and Resource Planning

As part of this contract a telemaintenance network was established between the TRA Action Center, Raytheon, L-3, and Edwards AFB to provide database information to all Agile team members, as well as to provide solutions to hardware and software maintenance problems that will arise during the flight test program.

During the next phase of the Agile support project, the telemaintenance network will be used extensively to check the status of additional spares ordering, to monitor delivery dates, and to determine spares/repairs locations.

Rapid Supply Chain Contracting

On this contract, TRA and its suppliers of Agile spares have demonstrated rapid supply chain contracting. All contractual arrangements, terms, and conditions had to be made in advance of placing orders to minimize a very lengthy pre-contracting process. We anticipate that agreements established during this phase of the Agile contract will demonstrate timely and cost-effective techniques during the next program phase.

Electronic Data Interchanges

Electronic data interchange development was the most significant Agile support technique contribution on this project. The electronic interchanges were concentrated mainly on spares ordering using the Internet and disseminating all program information to the Agile team via the telemaintenance network and database developments.

The electronic Purchase Request (PR) and Purchase Order (PO) forms were designed to duplicate the paper forms that exist at TRA. The intent is to provide electronically all information required by Purchasing to order components, without disrupting the process already in place at TRA. Most importantly, supplier relationships have to be undisturbed.

The process started with gathering information contained on existing paper PRs and POs and determining what fields would require coding to maintain the integrity of the new electronic order process. Upon completion of the process review, our team developed and implemented Web-based PR/PO forms. In designing the forms we defaulted or prefilled electronically, information applicable to all PRs/POs. Our strategy was twofold: to provide as much agility as possible and to minimize the number of errors introduced into the purchasing system.

Figure 3 shows the Agile Logistics Support Electronic Procurement Home Page, which is used internally on the TRA Intranet. Several options are available at this site, including developing a Purchase Request or Purchase Order online. Vendor data are automatically inserted as different vendors are selected. When the Purchase Order form is ready and authorized by procurement, vendor contracting officers selected receive an E-mail message automatically providing them with an address on the Internet to view the PO and informing them that a purchase has been placed.

We've Come a Long Way

The Agile support to the Global Hawk program is an 18-month contract to implement Agile support techniques in support of the first two Global Hawk High Altitude Endurance UAVs.

To recap our accomplishments, the Agile Support IPT has established a telemaintenance network with an Action Center at TRA and connections to Raytheon Systems Company in Los Angeles, Calif. (the payload supplier); L-3 Communications in Salt Lake City, Utah (the communications system supplier); and the flight test and maintenance center at Edwards AFB, Calif.

In addition, our team has put in place supplier relationships and commercial shipping practices to ensure rapid delivery of spares.

The Agile support project is a revolutionary implementation of rapid supply and responsive logistics support for the next generation of UAVs that will, ultimately, be used for worldwide reconnaissance.

Editor's Note: The author welcomes comments or questions concerning Agile Support to the Global Hawk Program. Contact her at **mklement@gdesystems.com** on the Internet.